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METHOD AND APPARATUS FOR CONDUCTING  
A TRANSACTION BETWEEN TRANSACTION  
PROCESSING SYSTEMS

BACKGROUND OF THE INVENTION

The present invention relates to a technique which can be preferably applied to a transaction processing system for conducting a transaction between  
5 a plurality of information processing devices.

Currently, the transaction processing system is used in various works. For example, the transaction processing system is used in plenty of works including banking work and reservation work in a travel agent.  
10 Moreover, these transaction processing systems are linked to other transaction processing systems. For example, when drawing a deposit from bank A and transferring it to bank B, the transaction to update an account database of bank A is linked to the transaction  
15 to update an account database of bank B.

When transactions are linked between systems as has been described above, a transaction ID (local ID) managed in each system is different in most cases and accordingly, it is necessary to use an ID which can  
20 be recognized by each other (ID generated according to a predetermined specification will be referred to as a standard ID) in order to link the transactions between the systems. The standard ID is in a standard format

common to the systems and defined by the standardization group or the like.

When a plurality of transactions are linked between systems by using the aforementioned standard ID, if any failure occurs in one of the transactions, the system detects the failure and records failure information. The failure information includes the local ID of the system but may not include the standard ID used when linked. When a failure occurs, the entry relating the standard ID to the local ID in a correspondence table is deleted and the failure investigation often requires a plenty of time.

It should be noted that for processing information by linking a plurality of information processing systems, there has been suggested a method for assuring information processing trace capable of assuring trace of each information processing (for example, see JP-A-2002-324001).

#### SUMMARY OF THE INVENTION

As has been described above, in the conventional transaction processing system, if a failure occurs in transaction processing performed by linking systems, the information relating a standard ID to a local ID is deleted and failure investigation requires a plenty of time.

It is therefore an object of the present invention to provide a technique to reduce the time

required for failure investigation for investigating a failure which has occurred in the transaction processing performed between a plurality of information processing devices.

5           The present invention relates to a transaction processing system for conducting a transaction between a plurality of information processing devices, wherein if a failure occurs during a transaction processing, the standard ID and the local  
10 ID are held for a predetermined period of time so as to generate mapping information for relating the local ID in each of the information processing devices.

          In the transaction processing system of the present invention, if a transaction processing started  
15 in a first information processing device requires a transaction processing in a second information processing device, firstly a standard ID is generated for relating the transaction processing in the first information processing device to a transaction  
20 processing in the second information processing device, after which a first local ID for identifying the transaction of the first information processing device is correlated with the aforementioned standard ID generated and the correlated ID's are stored in a first  
25 mapping table.

          Next, the standard ID and a transaction processing request are transmitted to the second information processing device to request execution of

the transaction processing in the second information processing device.

Upon reception of the standard ID and the transaction processing request from the first  
5 information processing device, the second information processing device generates a second local ID for identifying the transaction processing of the second information processing device, relates the received standard ID to the generated second local ID, stores  
10 them in a second mapping table, and executes the requested transaction processing.

If a failure occurs in the transaction processing being executed in the second information processing device, information on the time when the  
15 failure occurred is stored in a record in the second mapping table relating the standard ID of the transaction processing to the second local ID. The record is maintained for a predetermined period of time and occurrence of failure is notified to the first  
20 information processing device which has requested the execution.

Upon reception of a notification of occurrence of failure together with the standard ID from the second information processing device, the  
25 first information processing device specifies the standard ID and inquires about the second local ID of the transaction processing.

Upon reception of the inquiry with

specification of the standard ID from the first  
information processing device, the second information  
processing device reads out the second local ID  
corresponding to the specified standard ID from the  
5 second mapping table and transmits it to the first  
information processing device.

The first information processing device  
receives the second local ID transmitted from the  
second information processing device and reads out the  
10 first local ID corresponding to the specified standard  
ID from the first mapping table so as to generate  
mapping information relating the first local ID to the  
transmitted second local ID.

When investigating the failure which has  
15 occurred, failure information on the first information  
processing device is collected by using the first local  
ID and then failure information on the second  
information processing device is collected by using the  
second local ID related to the first local ID in the  
20 mapping information, thereby reducing the time required  
for investigation because the standard ID need not be  
investigated. Moreover, since the mapping information  
relates the first local ID to the second local ID, it  
is possible to remove the work required for matching  
25 the local ID's.

As has been described above, in the  
transaction processing system of the present invention,  
when a failure occurs during a transaction processing

linked with another transaction processing, the standard ID and the local ID are maintained for a predetermined period of time so as to generate mapping information relating the local IDs in the respective  
5 information processing devices with each other.

Accordingly, it is possible to reduce the time required for investigating a failure which has occurred during a transaction processing conducted between a plurality of information processing devices.

10 Other objects, features and advantages of the invention will become apparent from the following description of the embodiments of the invention taken in conjunction with the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

15 Fig. 1 shows brief configuration of a transaction processing system according to an embodiment of the present invention.

Fig. 2 shows brief configuration of a transaction processing apparatus 101 according to the  
20 present embodiment.

Fig. 3 shows a brief configuration of a transaction processing apparatus 102 according to the present embodiment.

Fig. 4 is a flowchart showing a processing  
25 procedure of the processing at the transaction execution requesting side according to the present embodiment.

Fig. 5 shows a processing example of a bank online processing system according to the present embodiment.

Fig. 6 shows a processing example of a travel agent online processing system according to the present embodiment.

Fig. 7 shows an outline of the standard ID according to the present embodiment.

Fig. 8 is a flowchart showing a processing procedure of the processing at the transaction executing side according to the present embodiment.

Fig. 9 shows a processing example when a failure has occurred in the transaction 21 according to the present embodiment.

Fig. 10 is a flowchart showing a processing procedure of a table entry deletion check according to the present embodiment.

Fig. 11 shows an outline of creation of the mapping table 208 in the transaction processing apparatus 101 according to the present embodiment.

Fig. 12 shows an outline of creation of the mapping information between the local ID "11" and the local ID "21" according to the present embodiment.

#### DESCRIPTION OF THE EMBODIMENTS

Description will now be directed to a transaction processing system for conducting a transaction processing between a plurality of

information processing devices according to an embodiment.

Fig. 1 shows brief configuration of a transaction processing system according to the embodiment. Transaction processing apparatuses 101 and 102 are computers or information processing devices where a transaction management program is executed. A transaction 11 and a transaction 21 in Fig. 1 represent business application programs.

As shown in Fig. 1, in the transaction processing system according to the present embodiment, transactions 11 and 21 are linked between a plurality of transaction processing apparatuses 101 and 102. When a failure occurs in the transaction 21, its standard ID "A" and the local ID "21" (the local ID represents 21 of the transaction ID) are maintained in a mapping table 2 until a predetermined period of time elapses. Upon reception of an inquiry from the transaction processing apparatus 101, the local ID "21" is transmitted to the transaction processing apparatus 101 so as to generate mapping information 1 for relating or corresponding the local ID "11" to the local ID "21".

When investigating the failure generated during linkage of the transactions, failure information 1 on the transaction processing apparatus 101 is collected by using the local ID "11" and then failure information 2 on the transaction processing apparatus



102 is collected by using the local ID "21" in the mapping information, thereby eliminating the investigation on the standard ID "A", which reduces the time required for failure investigation.

5           Fig. 2 shows a brief configuration of the transaction processing apparatus 101 according to the present embodiment. As shown in Fig. 2, the transaction processing apparatus 101 of the present embodiment includes a CPU 201, a memory 202, a magnetic  
10 disk device 203, an input device 204, and output device 205, a CD-ROM device 206, a communication device 207, and a mapping table 208.

          The CPU 201 is an apparatus for controlling the operation of the entire transaction processing  
15 apparatus 101. The memory 202 is a storage device for loading various processing programs and data used for controlling the operation of the entire transaction processing apparatus 101.

          The magnetic disk device 203 is a storage  
20 device for storing the aforementioned various processing programs and data. The input device 204 is a device for inputting various data for generating mapping information correlating the local ID of the self-apparatus with a local ID of the linkage  
25 destination apparatus where a failure has occurred.

          The output device 205 is a device for performing various outputs accompanying generation of the mapping information. The CD-ROM device 206 is a

device for reading out the content of the CD-ROM containing the aforementioned various processing programs. The communication device 207 is a device for performing communication with another processing apparatus via a network such as Internet and Intranet. The mapping table 208 is a table for storing the local ID of the apparatus related to the standard ID.

Moreover, the transaction processing apparatus 101 includes a transaction execution request processor 211, a local ID inquiry processor 212, and a mapping information generation processor 213.

The transaction execution request processor 211 is a processor for relating the local ID "11" for identifying the transaction 11 of the transaction processing apparatus 101 to the standard ID for relating the transaction processing of the transaction processing apparatuses 101 and 102, storing them in the mapping table 208, transmitting the standard ID and the transaction processing request to the transaction processing apparatus 102 to request for execution of the transaction 21 in the transaction processing apparatus 102.

When a failure occurs in the transaction 21 which has requested for the execution, the local ID inquiry processor 212 specifies the standard ID of the transaction 21 and inquires the local ID "21" for identifying the transaction 21. The mapping information generation processor 213 is a processor for

generating mapping information for relating the local ID "11" corresponding to the specified standard ID to the transmitted local ID "21".

The program for making the transaction processing apparatus 101 function as the transaction execution request processor 211, the local ID inquiry processor 212, and the mapping information generation processor 213 is recorded on a recording medium such as a CD-ROM, stored on a magnetic disk and then loaded on a memory to be executed. It should be noted that the recording medium for recording the aforementioned program may be a recording medium other than the CD-ROM. Moreover, the aforementioned program may be used by installing it from the recording medium onto an information processing device or by accessing the recording medium via a network.

Fig. 3 shows brief configuration of the transaction processing apparatus 102 according to the present embodiment. As shown in Fig. 3, the transaction processing apparatus 102 of the present embodiment includes a CPU 301, a memory 302, a magnetic disk device 303, an input device 304, and output device 305, a CD-ROM device 306, a communication device 307, and a mapping table 308.

The CPU 301 is an apparatus for controlling the operation of the entire transaction processing apparatus 102. The memory 302 is a storage device for loading various processing programs and data used for

controlling the operation of the entire transaction processing apparatus 102.

The magnetic disk device 303 is a storage device for storing the aforementioned various  
5 processing programs and data. The input device 304 is a device for performing various inputs for maintaining the standard ID and the local ID of the apparatus for a predetermined period of time after a failure has occurred.

10 The output device 305 is a device for performing various outputs accompanying holding of the standard ID and the local ID. The CD-ROM device 306 is a device for reading out the content of the CD-ROM containing the aforementioned various processing  
15 programs. The communication device 307 is a device for performing communication with another processing apparatus via a network such as the Internet and the Intranet.

The mapping table 308 is a table for storing  
20 the local ID of the apparatus related to the standard ID. A request origin monitoring time management table 309 is a table for storing time information for deleting the record of the transaction where a failure has occurred from the mapping table 308.

25 Moreover, the transaction processing apparatus 102 includes a transaction execution processor 311, a record holding processor 312, and a local ID response processor 313.

The transaction execution processor 311 is a processor for receiving the standard ID for relating the transaction processing of the transaction processing apparatuses 101 and 102 and the transaction  
5 processing request from the transaction processing apparatus 101, relating the standard ID to the local ID "21" for identifying the transaction 21 of the transaction processing apparatus 102, storing them in the mapping table 308, and executing the requested  
10 processing transaction 21.

When a failure occurs in the transaction 21 which has executed, the record holding processor 312 maintains the record in the mapping table 308 relating the standard ID of the transaction 21 to the local ID  
15 "21" for a predetermined period of time.

When a query is made with specification of the aforementioned standard ID, the local ID response processor 313 reads the local ID "21" corresponding to the specified standard ID from the mapping table 308  
20 and transmits it to the transaction processing apparatus 101.

The program for making the transaction processing apparatus 102 function as the transaction execution processor 311, the record holding processor  
25 312, and the local ID response processor 313 is recorded on a recording medium such as a CD-ROM, stored on a magnetic disk and then loaded on a memory to be executed. It should be noted that the recording medium

for recording the aforementioned program may be a recording medium other than the CD-ROM. Moreover, the aforementioned program may be used by installing it from the recording medium onto an information  
5 processing device or by accessing the recording medium via a network.

As shown in Fig. 2 and Fig. 3, this embodiment has been explained for a case that the transaction execution request side and the transaction  
10 execution side are realized by information processing devices having different configurations. However, it is also possible to use an information processing device having the configurations of both Fig. 2 and Fig. 3 and capable of requesting another apparatus to  
15 execute a transaction and executing a transaction requested from another apparatus.

Fig. 4 is a flowchart showing processing procedure of the processing performed by the transaction execution request side according to the  
20 present embodiment. As shown in Fig. 4, when execution of a transaction processing is required in the transaction processing apparatus 102 while performing processing of the transaction 11 started in the transaction processing apparatus 101, in step 401, the  
25 transaction execution request processor 211 of the transaction processing apparatus 101 generates a standard ID "A" for relating the transaction processing of the transaction processing apparatuses 101 and 102,

relates the local ID "11" for identifying the transaction 11 of the transaction processing apparatus 101 to the standard ID generated, and stores them in the mapping table 208.

5           As has been described above, there is a case that during a processing of a transaction started in a certain transaction processing apparatus, execution of transaction processing in another transaction processing apparatus is required. This can be seen in  
10 the bank online processing system and travel agent online processing system.

Fig. 5 shows a processing example of a bank online processing system according to the present embodiment. As shown in Fig. 5, In the A bank system  
15 501, a business application 502 is operating and a TP monitor and a database management system (DBMS) 504 are used. Moreover, in the B bank system 506, a business application 507 is operating and a TP monitor 508 and a DBMS 509 are used. The business application 502 is an  
20 application program for requesting a transfer and decreasing a specified money from the account database. The business application 507 is an application program for receiving the transfer request and increasing the specified money in the account database.

25           These transfer requests are performed via the TP monitor 503 and the TP monitor 508. However, these TP monitors may be of different vendors. For this, the transaction instruction 511 for requesting the

transaction start and the transaction instruction 512 for requesting settlement of transaction use the standard ID for recognizing each other instead of the local ID used in the TP (transaction processing)

5 monitors. By using this standard ID, it becomes possible to synchronize the transactions in the different TP monitors and perform transfer processing between different banks.

Fig. 6 shows a processing of a travel online  
10 processing system as the embodiment. The standard ID defined by the standard protocol is not limited to the processing between the TP monitors in Fig. 5. As shown in Fig. 6, it can also be used between a TP monitor and DBMS.

15 In the A travel agent system 601, a business application 602 and a TP monitor 603 are operating for management of a transaction. In the C air service company reservation system, a DBMS 605 is operating for management of a reservation database. Moreover, in the  
20 D hotel reservation system, a DBMS 608 is operating for management of a reservation database 609.

The business application 602 instructs a transaction start to the DBMS 605 and the DBMS 608 via the TP monitor 603. Next, an air service reservation  
25 processing and a hotel reservation processing are performed. Lastly, a transaction settlement is instructed to the DBMS 605 and the DBMS 608 via the TP monitor 603.



Since the business application 602 treats the processing for the respective DBMS's as one transaction, commit settlement is instructed only when both of the air service reservation and the hotel  
5 reservation are successful. When one of them or both of them fail, a roll back settlement is performed. Accordingly, there is no case that only one of the reservations is performed.

In this case also, the standard ID is used  
10 for instructing a transaction from the TP monitor to the DBMS. The TO monitor 603, the DBMS 605, and the DBMS 608 may be obtained from different vendors if they can handle the standard ID. If the B travel agent system uses the TP monitor 612 using the standard ID,  
15 the business application 611 also can participate in this system.

Thus, when linking transactions between different banks, a travel agent, an air service company, a hotel, and the like, the systems used there  
20 are usually different and the local ID's used are different. In such a case, the standard ID is used for relating the transactions to be linked in the respective systems.

Fig. 7 shows an outline of the standard ID  
25 according to the present embodiment. The standard ID is formatted as is defined in Fig. 7. The standard ID includes a format ID 701 for identifying the format, a global transaction identifier size 702 indicating the

size of the global transaction identifier, a branch modifier size 703 indicating the size of the branch modifier, and a data section 704 containing the global transaction identifier and the branch modifier.

5           The global transaction identifier in this standard ID contains information for identifying the transaction processing apparatus which has made the transaction execution request. By referencing this content, it is possible to identify the transaction  
10 processing apparatus which has made the execution request.

Next, in step 402, the transaction execution request processor 211 transmits the generated standard ID and the transaction processing request to the  
15 transaction processing apparatus 102 so that the transaction 21 is executed in the transaction processing apparatus 102.

Fig. 8 is a flowchart showing the processing procedure of the processing performed in the  
20 transaction execution side according to the present embodiment. As shown in Fig. 8, in step 801, the transaction execution processor 311 of the transaction processing apparatus 102 receives the aforementioned standard ID and the transaction processing request from  
25 the transaction processing apparatus 101 and proceeds to the processing of step 802.

In step 802, the local ID "21" is generated for identifying the transaction 21 started in the

transaction processing apparatus 102. After this, the received standard ID "A" is related to the generated local ID "21" and they are stored in the mapping table 308. Moreover, the global transaction identifier is  
5 read out from the data section 704 of the received standard ID and the information identifying the transaction processing apparatus of the request source or requester which has transmitted the transaction processing request is read out and stored in the column  
10 of the requester in the mapping table 308.

In step 803, execution of the requested transaction 21 is started and the execution state is monitored. Upon detection of the end of the transaction 21 whose execution has been started,  
15 control is passed to step 804.

Step 804 checks whether or not the transaction 21 has terminated abnormally by referencing the information indicating the end state of the transaction 21 which has terminated, so as to judge  
20 whether any failure has occurred in the transaction 21. If any failure is detected, control is passed to step 805. Otherwise, control is passed to step 806.

In step 805, the record holding processor 312 of the transaction processing apparatus 102 references  
25 the mapping table 308, searches mapping table 308 for the record matched with the local ID "21" of the transaction 21 which has been executed, reads out the corresponding standard ID "A", stores information

indicating the time of generation of the aforementioned failure in the record where the standard ID "A" is related to the local ID "21", and performs processing to hold the record without deleting it.

5               On the other hand, step 806 searches the mapping table 308 for the record matched with the local ID "21" of the transaction 21 which has been executed, reads out the corresponding standard ID "A", and deletes the record which relates the standard ID "A" to  
10 the local ID "21".

Step 807 generates information indicating the processing result of the transaction 21 which has been executed and notifies it together with the standard ID "A" read out in step 805 or step 806 to the transaction  
15 processing apparatus 101.

When the processing result of the transaction 21 is notified from the transaction processing apparatus 102, in step 403 of Fig. 4, the transaction execution request processor 211 of the transaction  
20 processing apparatus 101 references the notified processing result to check whether any failure has occurred in the transaction 21 which has made execution request in step 402. If failure has occurred, control is passed to step 404.

25               In step 404, the local ID inquiry processor 212 specifies the standard ID "A" received together with the processing result and inquires of transaction apparatus 102 the local ID "21" for identifying the

transaction 21 where the failure has occurred.

Upon reception of the inquiry with specification of the standard ID "A" from the transaction processing apparatus 101, the local ID response processor 313 of the transaction processing apparatus 102 reads out the local ID "21" corresponding to the specified standard ID "A" from the mapping table 308 and transmits it to the transaction processing apparatus 101.

10           The transaction processing apparatus 101 receives the local ID of the transaction 21 transmitted from the transaction processing apparatus 102, and in step 405 of Fig. 4, the mapping information generation processor 213 of the apparatus 101 searches the mapping  
15 table 208 for the record matched with the specified standard ID "A", reads out the corresponding local ID "11", and relates the local ID "11" to the aforementioned local ID "21" which has been transmitted, thereby generating mapping information.

20           On the other hand, if the check in step 403 indicates that no failure has occurred in the transaction 21, control is passed to step 406, where the record matched with the standard ID notified together with the processing result is searched from  
25 the mapping table and deleted.

Fig. 9 shows an example of processing performed when a failure has occurred in the transaction 21 of the present embodiment. As shown in

Fig. 9, if a failure occurs in the transaction 21 being executed in the transaction processing apparatus 102, the record holding processor 312 of the transaction processing apparatus 102 searches the mapping table 308, stores information on the time of the occurrence of the failure in the column of time in the record matched with the local ID "21" of the transaction 21 having the failure, and holds the record without deleting it until a predetermined deletion time indicated in the request origin monitoring time management table 309 elapses.

The request source monitoring time management table 309 contains the table monitoring interval indicating the time interval for monitoring the table and the deletion elapse time indicating the time which elapses until the record in the mapping table 308 is deleted after a failure occurs. By setting a short time for the deletion elapse time of the system 1 (transaction processing apparatus 101) having the function of the local ID inquiry processor 212 inquiring the local ID when a failure has occurred and a long time for the other system X, it is possible to prevent a case that a plenty of records remain for a long time without being deleted. Moreover, the local ID can also be acquired manually by a manager of the system X having no local ID inquiry function.

Fig. 10 is a flowchart showing a processing procedure of the table entry deletion check according

to the present embodiment. As shown in Fig. 10, the record holding processor 312 of the transaction processing apparatus 102 monitors the records in the mapping table 308 according to the information on the request source monitoring time management table 309 and delete the record whose deletion elapse time has elapsed after a failure occurred.

That is, in step 1001, the record holding processor 312 references the record on the mapping table and checks whether a value is stored in the column of time. If a value is stored, control is passed to step 1002. Otherwise, control is passed to step 1004.

Step 1002 reads out the request source in the record referenced in step 1001, references the request source monitoring time management table 309 and reads out the table monitoring interval and the deletion elapse time corresponding to the request source read out. It is checked whether the time indicated by the deletion elapse time has elapsed from the time in the record. If the time has elapsed, control is passed to step 1003 and the record is deleted from the mapping table.

After this, in step 1004, the record of the next entry is read out from the mapping table 308 and step 1005 checks whether check has been complete up to the final entry. If the check is complete, control is passed to step 1006. Otherwise, control is returned to

step 1001 for processing the next entry.

Step 1006 performs sleep processing for the value specified for the table monitoring interval read out in step 1002 and control is returned to step 1001  
5 for processing the first entry and after.

Fig. 11 shows an outline of creation of the mapping table 208 in the transaction processing apparatus 101 of the present embodiment. As shown in Fig. 11, if there arises a need of performing a  
10 transaction processing in the transaction processing apparatus 102 during processing of a plurality of transactions including transaction 11, the transaction processing apparatus 101 relates the local ID "11" to local ID 13 to the standard ID "A" to standard ID "B",  
15 stores them in the mapping table 208, and transmits a transaction start request or the like so as to request the transaction processing apparatus 102 to execute a transaction.

Fig. 12 shows an outline of creation of  
20 mapping information of the local ID "11" and the local ID "21" according to the present embodiment. As shown in Fig. 12, upon detection of a failure of the transaction 21, the transaction processing apparatus 101 specifies the standard ID "A", requests to acquire  
25 the local ID of the transaction 21, acquires the local ID "21", and creates the mapping information 1201.

After this, when investigating the failure which has occurred during linkage of the aforementioned



transaction, failure information on the transaction processing apparatus 101 is collected by using the local ID "11" and then failure information on the transaction processing apparatus 102 is collected by  
5 using the local ID "21" related to the local ID "11" in the mapping information 1201, thereby eliminating the investigation of the standard ID to reduce the time of failure investigation. Moreover, since the mapping information 1201 relates the local ID "11" to the local  
10 ID "21", it is possible to eliminate the matching work between the local ID's which requires great energy.

Moreover, when the transaction processing apparatus 101 performs a request for acquiring the local ID of the transaction 21 by specifying the  
15 standard ID "A", it is possible to acquire the information on the pointer indicating the storage position of the failure information on the transaction processing apparatus 102, store it in the mapping information, collect failure information on the  
20 transaction processing apparatus 101 by using the local ID "11", collect the failure information on the transaction processing apparatus 102 online by using the pointer of the local ID "21", and display the failure information on each system according to the  
25 time series of transaction linkage, thereby supporting the failure investigation.

As has been described above, according to the transaction processing system of the present

embodiment, if a failure occurs during linkage of transaction processing, the standard ID and the local ID are maintained for a predetermined period of time and mapping information is created by relating the  
5 local ID's between the information processing apparatuses. Accordingly, it is possible to reduce the time required for investigating a failure which has occurred in a transaction processing conducted between a plurality of information processing apparatuses.

10           According to the present invention, if a failure occurs during linkage of transaction processing, it is possible to reduce the time required for investigating the failure which has occurred in the transaction processing conducted between a plurality of  
15 information processing apparatuses.

          It should be further understood by those skilled in the art that although the foregoing description has been made on embodiments of the invention, the invention is not limited thereto and  
20 various changes and modifications may be made without departing from the spirit of the invention and the scope of the appended claims.